prove *without further investigation* (*e.g.* by Stokes's method) that if the components are zero initially they always will remain zero, for a similar argument applied to uniformly accelerated motion from rest would lead to a *reductio ad absurdum.* Does not the author, however, assume this inference? Again, in dealing with flow of a viscous liquid between two parallel plates, would it not be more correct to say that Hele-Shaw first made the experiments, and Stokes subsequently showed that the results were largely due to viscosity, although it was previously thought, and perhaps even incorrectly stated, that these motions represented an actual realisation of two-dimensional flow of perfect liquids?

(2) Prof. Timerding's introduction to "Graphical Statics" contains a praiseworthy attempt to bridge over the gap which so often exists between treatises of a purely theoretical character, and text-books dealing too exclusively with technical applications. In particular the author shows clearly the equivalence which exists between the equations of equilibrium of uniplanar analytical statics and the geometrical constructions of force diagrams, funicular polygons, and stress diagrams of loaded frameworks, such as roof trusses. It is not surprising to find the author compelled to limit the scope of his book to the simplest portions of the subject. By this means he rightly claims to have produced a handbook which is accessible to students possessing a limited knowledge of mathematics (including very elementary analytical geometry but excluding calculus), but which constitutes a self-contained and connected exposition of the subject-matter of which it treats. As the author points out, the book should show to the technical worker that he can derive help and elucidation even from apparently abstract theories, while, on the other side, the mathematician will see with pleasure how densely the path of practice is strewn with the finest flowers of theory.

(3) "Vibrations of Systems having One Degree of Freedom" is a tract of a rather more elementary character than the series of "Cambridge Mathematical Tracts" which have proved so useful already. It might afford a useful supplement to existing text-books for such students of physics as have attended a suitable course of preparation in the elements of the calculus and differential equations. The equations of free and forced oscillation with one coordinate are discussed, and are applied to such problems as the rolling of ships and its measurement by the pendulum. The main difficulty is for students to find time to read such tracts when they have so much other subject-matter to study; this difficulty can probably be overcome by placing the book in the hands of the lecturer rather than of the pupil. There is certainly much to be said for requiring students to get a clear understanding of vibrations with one degree of freedom before introducing them to the more general problem where there are several coordinates. So much for the use of the book by students of pure science. As for its use for the class of students for which it appears to be primarily intended, we can only express the opinion that the book tends in exactly the same direction as the two German works above reviewed, and we hope it will be as successful as they are in making such students appreciate the value of theoretical knowledge.

(4) "Leerboek der Werktuigkunde" (=Lehrbuch der Werkzeugkunde) is a text-book on elementary statics and dynamics treated without the calculus for use in the Dutch higher schools, and by private students. Both in the methods of treatment and exposition, and in the worked-out exercises, examples and questions for examination, this book closely resembles our numerous English school books on elementary mechanics. Its contents include uniformly accelerated motion, component and resultant velocities, relations between force, mass and acceleration, composition of coplanar forces and couples, centres of gravity, ordinary examples on equilibrium of bodies resting against one another, the principle of work, circular and harmonic motion, elementary moments of inertia, impact, and the so-called mechanical powers. This course of study is so familiar to English readers that further description is unnecessary. It may be noticed that while the familiar "first and second systems of pulleys" appear in the last-named section, allowance is made for passive resistances, such as friction, which is not always done in English books. On the other hand, the author still follows old customs in trying to deal with composition of velocities without the necessary explicit references to relative velocity, which last receives somewhat meagre attention, a plan which experience shows to lead to frequent mistakes on the part of students.

G. H. B.

## *OUR BOOK SHELF.*

*History of Biology.* By Dr. L. C. Miall, F.R.S. (The History of Science Series.) Pp. vii+151. (London: Watts and Co., 1911.) Price 1s. net.

THIS is a wise and instructive book, such as we have learned to expect from Prof. Miall. It is scholarly but restrained, so that the reader is not overwhelmed with too much learning. It is a model of terseness, yet it has that picturesqueness of illustration which is necessary if a history is to grip the ordinary mind. A book like this, which commands our warmest admiration, could not have been written except by one who had studied the history of biology for a long time, and at first hand.

After a brief reference to the biology of the ancients, the long cessation of scientific inquiry that followed, and the revival of knowledge, Dr. Miall sketches the history in five periods. The first (1530–1660) saw the fresh start of botany and zoology, the beginning of experimental physiology, the exploration of new lands. The second (1661–1740) was the period of the early microscopists, of discussions as to the meaning of fossils, of early comparative anatomy and taxonomy, and of inquiry into the sexes of flowers. The third (1741–1789) was the time of Linnæus and the Jussieus, of Réaumur, of the rise of the genetic or historical method as illustrated by the works of Montesquieu and Buffon, of inquiries into animal intelligence and instinct, the metamorphoses of plants, the function of the green leaf, and so on. The fourth period (1790–1858) is illustrated by Sprengel and the fertilisation of flowers, by Cuvier and palæontology, by Chamisso and alternation of generations, by von Baer and embryology, by the cell-theory, and by the investigation of

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the higher cryptogams. The fifth period is illustrated by Darwin and Pasteur.

At the end of the book there is an interesting chronological table—a good lesson in itself. There is reason for regret that students often take relatively little interest in the historical development of the science which they pursue. The excuse sometimes offered, that they have no time for "historical studies," is made impossible by a book like this, short and illuminating. It shows us, with singular success, how "Biology, which in the sixteenth century sent out only a few feeble shoots, has now become a mighty tree with innumerable fruit-laden branches. The vigour of its latest outgrowths encourages confident hopes of future expansion." J. A. T.

*Catalogue of the Lepidoptera Phalænæ in the British Museum.* Vol. x. Plates cxlviii–clxxiii. (London: Printed by order of the Trustees, 1911.) Price 20*s.*

Vol. x. of Sir George F. Hampson's great work on the moths of the world was issued in November, 1910, and was reviewed in Nature for February 23, 1911 (p. 539). It was published in advance of the plates, which were not quite completed, but which appeared in May of the present year. They number twenty-six, and on each plate thirty-two species are figured, making a grand total of 842 species figured out of 1222 described (except a few described in vols. viii. and ix.) in vol. x., and if we add to this number the 214 species figured in the text, we find that only a few species are described and not figured, and even of these most are recognisably figured elsewhere. The enormous number of species of insects makes this of great importance, and the close resemblance and frequent dull colouring of many species often makes it difficult to point out their characters by description alone. With these excellent illustrations it should be easy to identify most, if not all, the species represented, and it is to be regretted that we have not yet a sufficient series of illustrated works on other orders of insects besides Lepidoptera.

*The Mechanism of Weaving.* By Thomas W. Fox. Pp. xxii+604. Fourth edition. (London: Macmillan and Co., Ltd., 1911.) Price 7*s.* 6*d.* net.

Since the first edition of this book was reviewed in Nature on December 13, 1894 (vol. li., p. 149), 130 pages and twenty-six new illustrations have been added. Some parts of the work have been rearranged and others enlarged. The sections dealing with dobbies, Jacquards, figuring harnesses, card-cutting, picking, multiple shuttle boxes, letting off, taking up, beating up, loom adjustments, and reeds have all been extended; and those on gauze, lappets, and swivels have been rewritten. Descriptions of terry weaving, the automatic supply of weft to looms, and warp stop motions have been included in this edition, and also an index.

*Die Grundlehren der höheren Mathematik.* By Prof. G. Helm. Pp. xvi+420. (Leipzig: Akademische Verlagsgesellschaft, 1910.) Price 13.40 marks.

This is much more like an English school class-book than usually reaches us from Germany. Practically it is a revision course of pure mathematics for what we should call a degree standard. There are chapters on differential and integral calculus, analytical plane and solid geometry, differential equations, interpolation, and the elementary theory of vectors. The author has had in mind the requirements of technical students, and his illustrations of theory are mainly of a practical kind. Finally, there are nearly 400 diagrams, so that the "appeal to the eye" has not been neglected. M.

## LETTERS TO THE EDITOR.

*[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.]*

### The Duration of Geological Time.

There is at the present time a great discrepancy in the numerical values given for geological time by the various methods employed. Considering the period which has elapsed since the commencement of the Cambrian, the evidence afforded by the study of radio-active minerals suggests that its length is of the order of 500 million years. Arguments derived from the study of sedimentation give, according to recent writers, a space of time for the same period not exceeding 50 million years, and the method based on the salinity of the ocean gives a similar figure. It is with regard to sedimentation that I wish here to make a few remarks.

It is evident that at the present time the volume of post-Eozoic sediments in existence is greater than ever it has been, and also that it is slowly increasing at the expense of the igneous and pre-Cambrian rocks now exposed to denudation. Knowing the rate of this denudation and the total volume of these sediments, all of which must necessarily have had their origin in igneous and pre-Cambrian rocks, the period represented by the fossiliferous strata is given by a simple process of division.

Situated as I am in Africa, without any geological literature, I can only give the most approximate estimates of the necessary factors with which to illustrate the method and arrive at the required length of time.

Sollas gives the thickness of the post-Eozoic sediments as 250,000 feet, or approximately 50 miles.

If we suppose all the sediments to be deposited at the maximum rate, they will form a regular bed along the continental shores for a distance of 35 miles seawards. Taking 100,000 miles as the average shore line of the Cambrian and subsequent periods, we arrive at the total volume of sediments—$175\times10^6$ cubic miles. This spread over the whole globe represents a thickness of seven-eighths of a mile.

The average rate of continental denudation is probably 1 foot in 5000 years, or 1 mile in 26 million years. The continental area is 56 million square miles, one quarter of which is occupied by igneous and pre-Cambrian rocks, *i.e.* 14 million square miles. The rate of denudation of the latter is therefore 14 million cubic miles in 26 million years. The time for all the sediments to collect at that rate would be 325 million years. This figure is only an indication of the order of the time elapsed. It requires to be corrected for the following factors:—

A. Factors tending to decrease the estimate.

(1) Exposed surface of igneous and pre-Cambrian rocks may have been greater in former ages.

(2) Marine denudation of igneous and pre-Cambrian coasts.

(3) Greater density of igneous rocks than of sediments.

B. Factors tending to increase the estimate.

(1) Average land area has probably been about 0·8 that of to-day.

(2) Average continental mean height has probably been below that of to-day.

(3) Recent glaciation has laid bare many pre-Cambrian areas.

(4) Present is a volcanic period, increasing the weathering capacity of rain.

(5) Present climates are of maximum variability.

(6) Parts of land area are subject to deposition, *i.e.* negative denudation.

(7) Unconformities not represented by sediments elsewhere.

(8) Some sediments at great depths may have become igneous rocks.

It is hoped that, with the increase of accurate quantitative knowledge of former conditions, and of the processes

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